Friction and Elevator Problems

Newton's Second Law

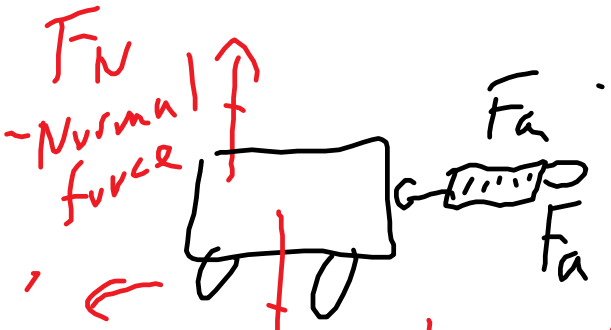
$F_{net}=ma$

$F_{net}=\Sigma F$

1. You pull a 2.0 kg cart with 3.0N of force.

a) if the friction of the wheels is negligible, what is the acceleration of the cart?

$F_f = 0$



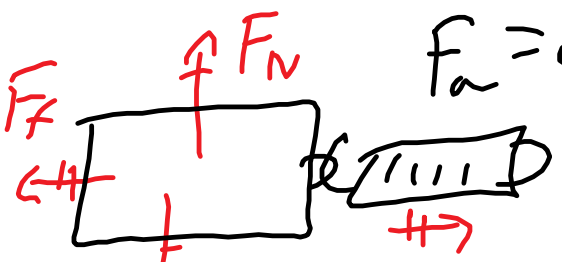
$a = \frac{F_{net}}{m} = \frac{3.0N}{2.0kg}$

$a = 1.5 m/s^2$

$F_N = F_g$ if a up/down = 0

- elevator $F_N \neq F_g$

b) if you pull 2.0 kg of wooden blocks with 2.0 N of force, they slide at a constant velocity. What is the i) acceleration ii) force of friction, F_f iii) force of gravity, F_g iv) force the ground pushes up on the cart (the Normal force, F_N)



i) $a = \frac{\Delta v}{\Delta t} = 0$

ii) $F_f = F_a$ if $a = 0$

$F_f = 2.0N$

iii) $g = 9.8 m/s^2$

iii) $g = 9.8\ m/s^2$

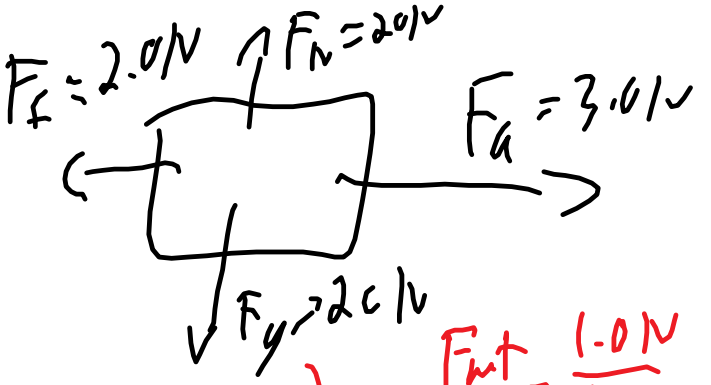
$F_g = mg = 2kg\ 9.8\ m/s^2$

$= 19.6N \approx \boxed{20N}$

iv) $F_N = F_g = \boxed{20N}$

The normal force, F_N, is the force the surface pushes back on the blocks perpendicular to the surface. (Normal - perpendicular)

c) if you pull the 2.0 kg of blocks with 3.0 N of force assuming they have the same force of friction from b, what is the i) net force ii) acceleration



i) $F_{net} = \sum F$ sum

$F_{net} = F_a - F_f$

$= 3.0N - 2.0N = \boxed{1.0N}$ direction

ii) $a = \frac{F_{net}}{m} = \frac{1.0N}{2.0kg} = \boxed{0.50 m/s^2}$

d) the coefficient of friction, μ, is defined as the ratio of the force of friction to the normal force.

$\mu = F_f / F_N$ what is the coefficient of friction for the blocks?

$\mu = F_f / F_N = 2.0N/19.6N = 2/19.6 = 0.102 = 0.10$

$\mu = 0.10$ no units - coefficient is a ratio of the forces

What factors influence the coefficient of friction?
Lab next class

e) How could you determine factors that influence μ experimentally? Lab next class.

How do you measure the force of friction?
easy way - pull at constant velocity on a level surface
applied force = force of friction
to measure the weight, lift the block with the force scale.

1. You lift a block with a force scale and measure 2.8N. You pull the block, it just starts moving when the applied force is 1.00N and 0.80 N are required to keep it moving at a constant speed. What is

a) the mass of the block, in kg?
b) the coefficient of static friction (not moving)
c) the coefficient of kinetic friction (moving)

2. You stand on a scale that reads in Newtons, in an elevator. If you are 50.0 kg, what value does the scale read

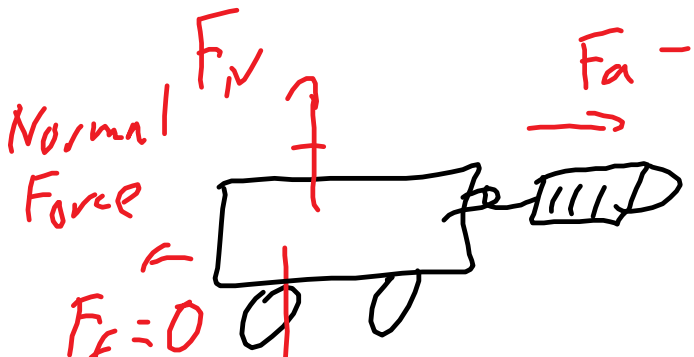
a) when you are at rest at the ground floor?
b) when you accelerate up at 2.0 m/s^2?
c) when you move up at a constant 3.0 m/s?
d) when you slow down at -4.0 m/s^2.
e) when you are at rest at the 10th floor.
f) when someone cuts the cable and your elevator

falls at -9.80m/s^2?
p102 practice problems 13-16
p103 CR 2.1-2.4
corrections to the test - hand in for marks next class

Block 1-2
Lab next class - Friction
Quiz Forces Thursday Nov 17th

1. You pull a 2.0 kg cart with 3.0N of force.

a) if the friction of the wheels is negligible, what is the acceleration of the cart?



F_a - Applied force = 3.0 N

$a = \frac{F_{net}}{m} = \frac{\Sigma F}{m} = \frac{3.0\,N}{2.0\,kg}$

$a = 1.5\,m/s^2$

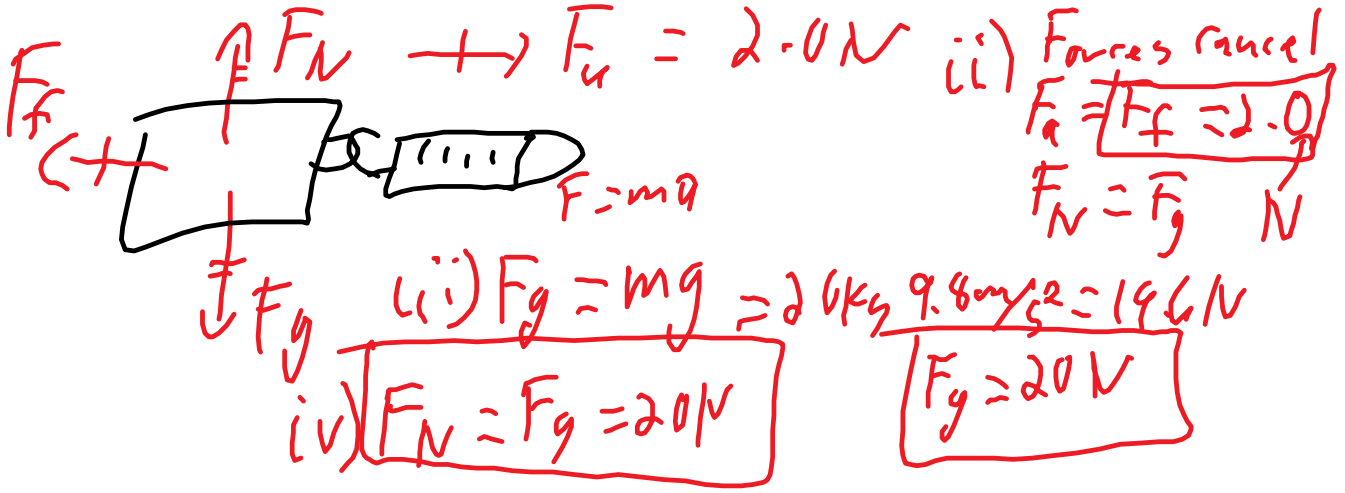
if a up/down = 0 $F_N = F_g$, elevator $F_N \& F_g$

The normal force is the force the surface pushes back with - perpendicular to the surface.

b) if you pull 2.0 kg of wooden blocks with 2.0 N of force, they slide at a constant velocity. What is the i) acceleration ii) force of friction, F_f iii) force of gravity (weight), F_g iv) force the ground pushes up

gravity (weight), F_g iv) force the ground pushes up on the cart (the Normal force, F_N)

i) $a = \frac{\Delta v}{\Delta t} = 0$

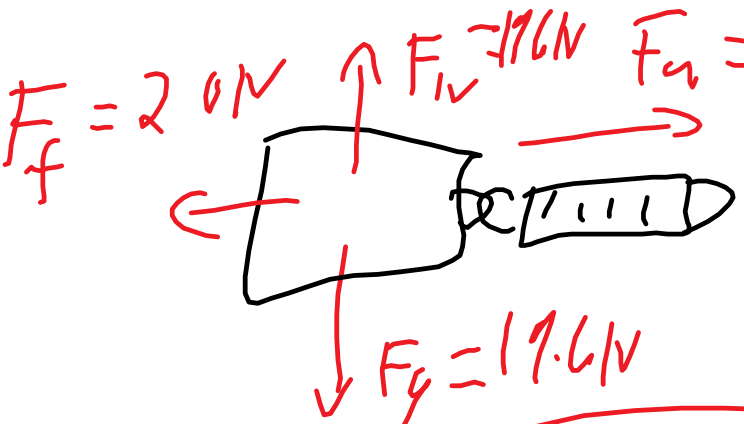


ii) Forces cancel
$F_a = F_f = 2.0$
$F_N = F_g$ N

iii) $F_g = mg = 2.0kg \cdot 9.8 m/s^2 = 19.6N$
$F_g = 20N$

iv) $F_N = F_g = 20N$

c) if you pull the 2.0 kg of blocks with 3.0 N of force assuming they have the same force of friction from b, what is the i) net force ii) acceleration



i) $F_{net} = \Sigma F$
$F_{net} = F_a - F_f$
$F_{net} = 3.0N - 2.0N$
$= 1.0N$

ii) $a = \frac{F_{net}}{m} = \frac{1.0N}{2.0kg} = 0.50 m/s^2$

d) the coefficient of friction, μ, is defined as the ratio of the force of friction to the normal force.

$\mu = F_f / F_N$. What is the coefficient of friction between the blocks and the table?

$\mu = F_f / F_N = 2.0N/19.6N = 0.10$ no units, a ratio

e) How could you determine factors that influence μ experimentally? Lab next class.
think of 4 factors you can test.